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Dwarf Mistletoe on Sugar Pine

By Robert F. Scharpf[1] and Frank G. Hawksworth[2]

Dwarf mistletoe (*Arceuthobium campylopodum* f. *blumeri* [A. Nelson] Gill)—a parasitic seed-bearing plant—causes serious damage to stands of sugar pine (*Pinus lambertiana* Dougl.) in California and southern Oregon. The parasite is usually found throughout the natural range of sugar pine in the mountains of southern California, in the Sierra Nevada and North Coastal Mountains of California, and in the southern Cascades. Dwarf mistletoe is not known in the isolated sugar pine stands in Nevada, in the southern Coast Range in California, and in Baja California, Mexico. It has occasionally been found on western white pine (*P. monticola* Dougl.) in northern California and southern Oregon.

The sugar pine type comprises about 13 percent of the commercial forest land of California and makes up about 8 percent of its commercial timber volume. Forest disease surveys by the U.S. Forest Service from 1958 to 1965 showed that dwarf mistletoe had infected about 22 percent of the sugar pine stands and slightly more than 10 percent of the trees in these stands. Most in-

[1] Plant pathologist, Pacific Southwest Forest and Range Exp. Sta., Forest Serv., U.S. Dep. of Agr., Berkeley, Calif.

[2] Plant pathologist, Rocky Mountain Forest and Range Exp. Sta., Forest Serv., U.S. Dep. of Agr., Fort Collins, Colo.

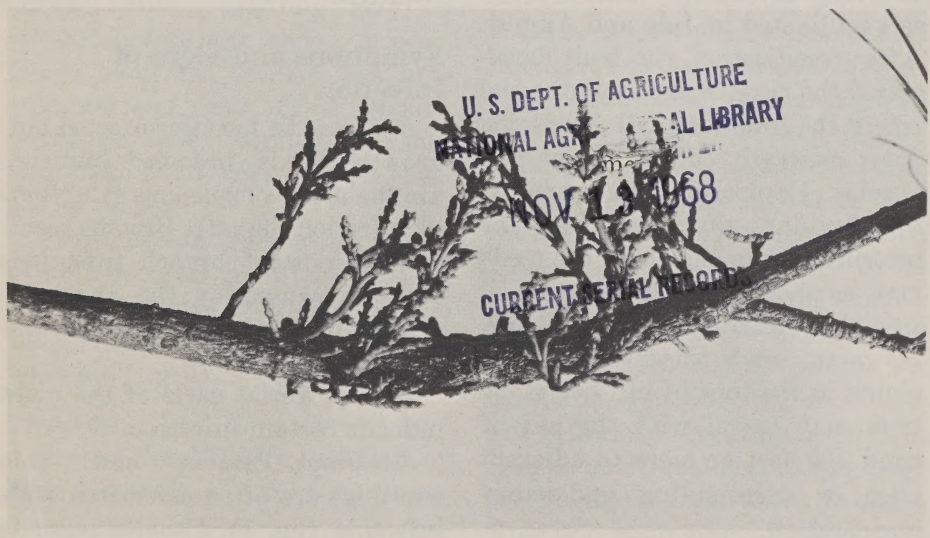
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Figure 1.—Branch of sugar pine infected by dwarf mistletoe. The leafless, segmented shoots arise from the swollen part of branch tissue.

fected stands were found on moderately productive sites.

Life History

The aerial system of dwarf mistletoes consists of small leafless, yellow to yellowish-green segmented shoots usually 3 to 4 inches long (fig. 1). The shoots contain chlorophyll and elaborate some of their own carbohydrates. But the parasite gets most of its nutrients from the living tissues of the host through a specialized rootlike system. This system consists of cortical strands that grow through the phloem and cortical tissues of the host and of secondary rootlike structures (sinkers) that become imbedded within the woody tissues of the host.

Male and female flowers are produced on separate plants. Small inconspicuous flowers arise from the axils of the shoot segments. When ripe, the female flowers exude small droplets of nectar and are insect-pollinated in July and August. After fertilization, the fruit develops in the next 13 to 14 months and ripens the following fall. Seeds disperse generally in September and October. Explosively discharged by the buildup of internal water pressure within the fruit, the seeds may be shot horizontally 40 to 50 feet, but usually somewhat less. However, seeds discharged from plants in the tops of tall overstory trees may travel with the aid of wind 100 feet or more to adjacent trees or surrounding understory regeneration.

The seeds are sticky and will adhere to most objects they strike. Commonly they first become attached to the foliage of trees. They remain on the needles until the first rain when the seeds absorb moisture, become slippery, and slide down the needles to the branch at the base of the needle fascicle, sticking to the bark. Germination is in spring. The growing radicle usually penetrates the branch of a susceptible tree at the base of the needle fascicle. Infection is established by midsummer although the first shoots do not usually appear for 2 or more years. Once the parasite reaches the living tissues of the host, it no longer depends on its own nutrient supply, and the plant develops subsequently from the enlarging rootlike system within the branch. The minimum time required for a female plant to complete its life cycle (seed dispersal to production of a new seed-bearing plant) is 3 years, but more often at least 4 to 5 years are required.

Symptoms and Signs of Infection

Brooms. In heavily infected old-growth stands, broomed branches are the most conspicuous symptoms of infection (fig. 2). Brooms result from persistent branch infections and are caused by the abnormal growth of numerous branches and twigs.

Plants. Aerial parts of the plant indicate certain infection.

Swellings. Branch and bole swellings are often associated with infection (fig. 1). Usually parasite shoots arise from the area of swollen tissue. But for young infections lo-

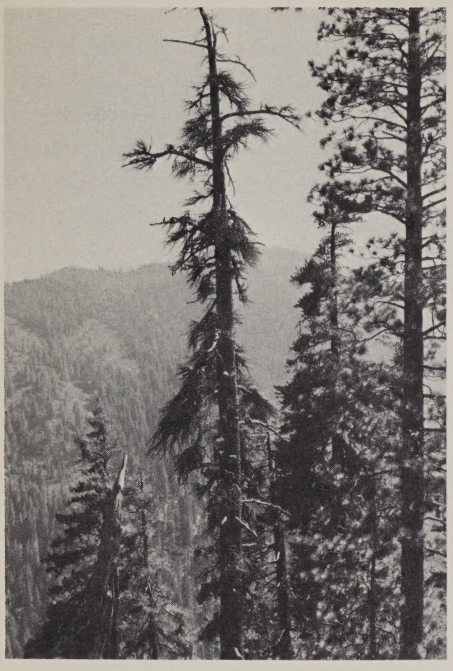

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Figure 2.—Dead, overmature sugar pine killed because of heavy infection by dwarf mistletoe and attacks by bark beetles. Brooms are conspicuous.

calized branch swelling may be present before any shoots appear. Older swellings become less pronounced and bear fewer shoots. Often on older swollen branches only the basal cups of previous shoots remain.

Sparse crown. Tree crown size of older trees is commonly reduced by heavy infection. Often nearly all the foliage is contained in the broomed branches (fig. 2).

Damage

Growth loss. Heavy infection by dwarf mistletoe considerably reduces tree height and diameter growth, particularly in badly infected old-growth trees. Younger trees also lose dominance if severely infected.

Mortality. Young trees, especially those with main stem infections, can succumb to dwarf mistletoe. Those weakened by numerous branch infections cannot compete successfully with surrounding trees and are eventually crowded out. Mature and overmature trees weakened by dwarf mistletoe are often attacked and killed by bark beetles; considerable volume loss results (fig. 2).

Quality Reduction

Old-growth sugar pine, prized for its high-quality wood, is often reduced in quality by large knots developing from persistent broomed branches. Infections of the main stem may also result in pitchy, cross-grained, wood of low grade.

Control

Among the several attempts to control dwarf mistletoe, sanitation is the most satisfactory. Once dwarf mistletoe has been reduced to a low level or eliminated from an area, reinfection takes place very slowly.

In commercial stands, all infected merchantable trees should be harvested. The parasite spreads mostly from the infected overstory to the understory trees. After the stand is harvested, infected residual trees should be removed or pruned for maximum control. Small trees with few infections benefit by pruning as long as individual branch swellings are no closer than about 6 inches from the main stem. Pruned trees should be checked and, if necessary, pruned again after 5 years to re-

move latent infections appearing since the first operation.

Pruning of larger trees or trees with numerous infections is usually not practical. Therefore, removal of the larger nonmerchantable trees with several to many infections is suggested for control. The larger trees with main stem infections only need not be removed. Main stem infections covered by well-developed bark bear few shoots and contribute little to the spread of the parasite.

Dwarf mistletoe spreads at a rather slow rate in even-aged stands. Therefore, any silvicultural treatment that will create an even-aged stand will reduce damage from dwarf mistletoe. And, under even-aged stand conditions, a mixed species composition discourages the spread of dwarf mistletoe. Nonsusceptible trees (any species other than sugar or western white pines) interspersed with susceptible trees intercept dwarf mistletoe seeds and help to limit spread of the parasite. The replanting of sugar pines next to areas of known infection should be avoided.

Occasionally, control is needed to prolong the life of large high-value trees on campsites and other special-use areas. When adequate tree crown is present, high pruning of large brooms can increase the vigor of individual trees. Large brooms often break off during strong wind and under heavy snowpack. Therefore, their removal also reduces a potential hazard in high-use areas.

Herbicides are being tested for direct control of dwarf mistletoe on sugar pines. But they are not yet being used on an operational basis.

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